

Cellular response to bleomycin-induced DNA damage in human fibroblast cells in space

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Living organisms are constantly exposed to space radiation that consists of energetic protons and other heavier charged particles. Whether spaceflight factors, microgravity in particular, affects on the cellular response to DNA damage induced by exposures to radiation or other toxic chemicals will have an impact on the radiation risks for the astronauts, as well as on the mutation rate in microorganisms, is still an open question. Although the possible synergistic effects of space radiation and other spaceflight factors have been investigated since the early days of the human space program, the published results were mostly conflicting and inconsistent. To investigate the effects of spaceflight on the cellular response to DNA damages, human fibroblast cells flown to the International Space Station (ISS) were treated with bleomycin for three hours in the true microgravity environment, which induces DNA damages including the double strand breaks (DSB) similar to the ionizing radiation. Damage in the DNA was measured by the phosphorylation of a histone protein H2AX (γ -H2AX), which showed slightly more foci in the cells on ISS than in the ground control. The expression of genes involved in the DNA damage response was also analyzed using the PCR array. Although a number of the genes, including CDKN1A and PCNA, were significantly altered in the cells after bleomycin treatment, no significant difference in the expression profile of DNA damage response genes was found between the flight and ground samples. At the time of the bleomycin treatment, the cells on the ISS were found to be proliferating faster than the ground control as measured by the percentage of cells containing positive Ki-67 signals. Our results suggested that the difference in γ -H2AX between flight and ground was due to the faster growth rate of the cells in space, but spaceflight did not affect the response of the DNA damage response genes to bleomycin treatment.